

the Air Force's top-of-the-line F-15 fighter. This relationship in cost is caused not only by the heavier structure dictated by carrier operations, but also because of the demanding Navy mission of defending aircraft carriers. Therefore, this study has assumed that the cost ratio for the F-15 and the ATF will also hold for the F-14 and the Navy ATF.

HISTORICAL TRENDS IN THE COSTS OF NAVY AIRCRAFT

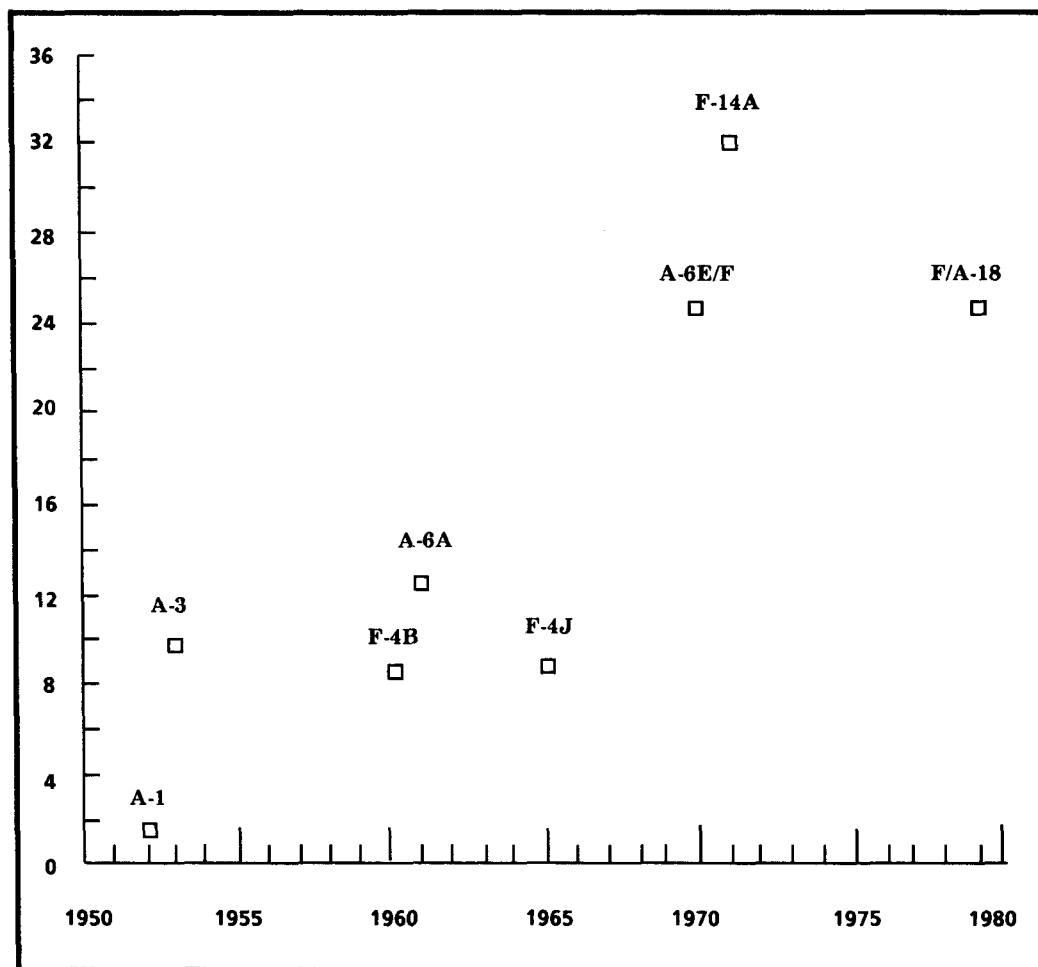
The Air Force estimates of the cost of the ATF exceed the cost of the Air Force F-15 aircraft by about 50 percent, though capability is supposed to increase by a much larger percentage. As noted above, one Navy source has indicated that the ATA would cost about the same as current Navy bombers, though former Secretary Lehman seemed to imply that the plane would cost 60 percent more than the A-6E.

All of these estimates are markedly lower than historical cost increases, in real terms, for Navy aircraft over previous equivalent aircraft.^{6/} Figure 6 shows the total average unit flyaway cost for each plane.^{7/} Flyaway costs for the A-6E, for example, are about 150 percent higher than those for the A-3, the Navy's heavy bomber in the 1950s. (Flyaway costs are a level of aggregation that exclude some procurement funding for items like spares and ground support equipment.) Moreover, the A-6E costs about 750 percent more than the A-1, a medium bomber that some analysts have described as the A-6's real predecessor.^{8/} The time period between the first A-1 and A-3 procurements and the first A-6E procurement is about comparable

6. In fact, these estimates are lower than the cost increase associated with model changes for the A-6; costs of the E/F model were roughly double those of the A model. And the F-14's flyaway cost--defined as costs of the plane excluding support equipment and initial spares--is projected by the Navy to increase by about 60 percent when the plane's "D" model is produced.
7. Some analysts would argue that costs should be for equivalent units (for example, the two-hundredth unit built) rather than for average total units, since the total average favors planes with high procurement rates and large total quantities. Since cost often determines quantity, however, this measure was used.
8. Norman Friedman, *Carrier Air Power* (Greenwich, England: Conway Maritime Press, 1981), p. 75.



FIGURE 6. TOTAL AVERAGE UNIT FLYAWAY COSTS OF NAVY ATTACK AND FIGHTER AIRCRAFT, BY FIRST YEAR OF PROCUREMENT (In millions of 1988 dollars)



SOURCE: Congressional Budget Office estimates from data presented in Management Consulting and Research, Inc., *The U.S. Military Aircraft Cost Handbook* (Falls Church, Va.: MCR, March 1983); and Selected Acquisition Reports to the Congress, various years.

to that between A-6E procurement and ATA procurement--roughly 20 years.

Attack aircraft are not alone in experiencing cost increases from generation to generation. The F-14, for example, costs about 260 percent more than its predecessor, the F-4. Even the F/A-18, designed to be a less capable cousin of the A-6 and F-14, is about 200 percent more expensive than the F-4. Cost growth between generations of

aircraft is also experienced in other services. An earlier CBO study detailed similar results for Air Force aircraft.^{9/}

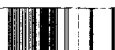
IMPACT OF COST AND OTHER FACTORS ON FORCE SIZE

The eventual cost of these two planes will have important effects on the Navy's ability to maintain and expand its forces. In order to assess these effects, the analysis projected the percentage of the Navy's fighter/attack requirements that it could buy by the year 2015--when ATAs and the Navy ATFs should be in the fleet in large numbers--as a function of cost and other factors. Requirements in the year 2015 were assumed to be equal to those in 1994, the last year for which Department of the Navy estimates are available.

Key Assumptions

Several key assumptions underlie the projections. Annual real growth of 3 percent above funds allocated in the 1987 budget for procurement of fighter/attack aircraft (that is, F-14s, A-6s, and F/A-18s) was assumed. Three percent approximates long-term historical growth in the gross national product (GNP) and so could indicate what would happen to defense spending, and thus perhaps to aircraft spending, if defense maintains its current share of GNP. It was also assumed that the Navy would maintain the current ratio among types of aircraft rather than shifting, say, to a mix richer in sophisticated and expensive planes. This assumption may be reasonable since it appears that the Navy plans a roughly one-for-one replacement of F-14s and A-6s with new aircraft.^{10/} Navy requirements for the three fighter/attack aircraft in the year 2015 are assumed to be about 1,860--the requirements associated with 14 active air wings, two reserve wings, and the Marine Corps' fighter and medium-attack forces in 1994. Finally, the study assumed that the Navy continues to

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9. Congressional Budget Office, *Tactical Combat Forces of the United States Air Force*.
 10. Since new planes are typically expected to have much better capabilities than old ones, it might seem logical to assume that fewer of them would be needed. Improvements in capability, however, are frequently undertaken to "keep up" with projections of increases in qualitative or quantitative capability of the enemy.



buy the lower-cost aircraft now in production--the F/A-18--throughout this period. Consistent with experience with the F-14, however, improvements in the F/A-18 were assumed to add 3 percent a year to its real cost. Obviously, these assumptions are all highly uncertain. A later section discusses the effects of alternative values for some of these variables.

Trends in Future Force Levels

The analysis suggests that, if actual events parallel the Navy's current assumptions, the service should be able to meet its requirements for aircraft with 3 percent annual budget growth. The Navy argues that it will keep current aircraft at least 25 years and that the ATA will cost roughly 60 percent more than the A-6. The Air Force expects its ATF to exceed the cost of its current F-15 aircraft by 50 percent, and this growth was assumed to apply to the Navy ATF in relation to the F-14. Under these assumptions, the Navy in the year 2015 should meet its requirements.^{11/} Specifically, it would meet 102 percent of them (see Table 11). Indeed, if some of the Navy's more optimistic estimates turn out to be true (the ATA costs no more than the A-6, planes remain in the inventory for 30 years), it could more than meet its requirements. Stated another way, there would be room for accommodating other sources of increases in costs or decreases in available funds.

On the other hand, as noted above, current Navy and Air Force estimates of increases in costs for the ATA and Navy ATF are much lower than those actually experienced between earlier generations of aircraft. If history is a guide, increases of factors of 2 to 3 are more realistic than increases of only about 1.5. Moreover, the Navy anticipates keeping both the F-14 and A-6 in the inventory between 25 years and 30 years. Though a few A-6 aircraft now exceed 25 years of age, the Navy has never kept large numbers of aircraft that long. For example, the Navy is currently retiring its F-4 fighter aircraft at around 19 years of service.

11. The analysis assumes that procurement unit costs will increase by the same percentages as flyaway costs. Historical data for aircraft costs were available only at the flyaway level of aggregation. Should procurement costs increase at a different rate, the results of the analysis would be different.

If actual events parallel this history rather than the Navy's estimates, the Navy will not be able to meet its numerical requirements for aircraft. One set of assumptions consistent with cost history (increases of 2.5 in ATA costs over the costs of the A-6, and 2.8 in Navy ATF costs over costs of the F-14) allows the Navy to meet only 76 percent of its requirement in the year 2015, assuming current planes remain in the inventory until 25 years of age. That percentage drops

TABLE 11. PERCENTAGES OF FIGHTER/ATTACK REQUIREMENTS MET IN THE YEAR 2015, ASSUMING 3 PERCENT ANNUAL BUDGET GROWTH

Cost Ratio of Navy ATF to F-14	Aircraft Age at Retirement	Cost Ratio of ATA to A-6		
		1.0 (Lowest Navy estimate)	1.6 (Navy estimate)	2.5 (Cost Ratio of A-6E to A-3)
1.5 <u>a</u> /	30 years	125*	114*	102*
	25 years	112*	102*	90
	20 years	98	89	77
2.8 <u>b</u> /	30 years	104*	97	89
	25 years	92	85	76
	20 years	78	72	64
3.6 <u>c</u> /	30 years	96	90	83
	25 years	83	77	70
	20 years	69	64	58

SOURCE: Congressional Budget Office estimates using historical data from Management Consulting and Research, Inc., *The U.S. Military Aircraft Cost Handbook* (Falls Church, Va.: MCR, March 1983), and Selected Acquisition Reports to the Congress, various years; and Department of the Navy projections of future aircraft costs.

NOTE: * = meets or exceeds Navy requirements.

- a. Air Force estimate of the cost ratio of the ATF to the F-15.
- b. Historical cost ratio of the F/A-18 to the F-4.
- c. Historical cost ratio of the F-14 to the F-4.



to 64 percent if aircraft retire at 20 years, which may be more consistent with past experience.

Sensitivity to Assumptions

Results in Table 11 are quite sensitive to a variety of assumptions that are highly uncertain. While this sensitivity argues for great caution in using these results, there are as many plausible alternative assumptions that yield more pessimistic results as there are alternative assumptions that improve the chances of meeting Navy requirements.

Several alternative assumptions are analyzed in Table 12. The analysis chooses as a base case a selected group of assumptions--service estimates of cost growth (ATA to A-6 = 1.6, Navy ATF to F-14 = 1.5) and retirement at 25 years--and then varies them one at a time to indicate the sensitivity of the analysis. Several changes improve chances of meeting requirements, increasing the estimate of requirements met above 100 percent. These favorable assumptions include no growth in the real cost of the low-mix aircraft (the F/A-18), or a decrease in requirements back to levels consistent with 13 aircraft carriers and 12 air wings rather than the 15 carriers and 14 wings planned by the Navy.

Table 12 also shows several assumptions that would make it less likely that the Navy could meet its requirements. One assumption is that the Navy, in the face of improving Soviet capability, decides to retire aircraft after 15 years of service (an earlier Navy goal). Another is that ATA costs increase by a factor of 8.5 (equal to the ratio of A-6 costs to those of the A-1). This latter assumption implies that the ATA has a procurement unit cost of about \$260 million in today's dollars. While this cost may seem ludicrous, it might have been regarded as equally ludicrous in 1950 to suggest that the A-6A would have a flyaway cost of \$9.3 million apiece, or that the A-6E/F would have a flyaway cost of about \$25 million when the Navy was buying the A-1 at a flyaway cost, in today's dollars, of only \$1.5 million.

Alternative Assumptions about Budget Growth

Another key assumption concerns annual budget growth. The analysis in Tables 11 and 12 assumes 3 percent annual growth. As the earlier chapters on the Navy budget discuss, however, increases of 3 percent in the DoD budget over the long term may be unrealistic and are certainly higher than the negative real growth planned by the Congress over the next few years.

If real growth of 1 percent is assumed instead, Navy requirements would not be met in any of the cases considered, and substantial shortfalls could occur in several cases that are entirely plausible (see Table A-1 in the Appendix). Assumptions of this low growth might be consistent with growth in the economy well below historical norms, which constrains defense growth. Perhaps more realistically, such a

TABLE 12. PERCENTAGES OF FIGHTER/ATTACK AIRCRAFT
REQUIREMENTS MET IN THE YEAR 2015
UNDER ALTERNATIVE ASSUMPTIONS

Base Case Assumptions <u>a</u> /	102
Base Case, except no growth in cost of low-mix aircraft (the F/A-18)	124
Base Case, except lower requirements (consistent with 13 carriers, 12 wings)	112
Base Case, except retirement at 15 years of age (Navy goal)	73
Base Case, except ATA costs 8.5 times A-6 (similar to cost ratio of A-6 to A-1)	52

SOURCE: Congressional Budget Office estimates using historical data from Management Consulting and Research, Inc., *The U.S. Military Aircraft Cost Handbook* (Falls Church, Va.: MCR, March 1983), and Selected Acquisition Reports to the Congress, various years; and Department of the Navy projections of future aircraft costs.

- a. Assumes Navy and Air Force estimates of cost growth (ATA to A-6 = 1.6, Navy ATF to F-14 = 1.5) and retirement at 25 years.



low percentage of growth in the Navy's budget for fighter and attack aircraft might be consistent with decisions to reallocate funds from the Navy aircraft procurement account to Navy ships or, perhaps, to other defense programs such as deployment of a comprehensive strategic defense system.

On the other hand, if funds available for fighter and attack aircraft grow by 5 percent a year in real terms, then the Navy could meet its requirements under a wide variety of assumptions (see Table A-2 in the Appendix). Indeed, with such growth the Navy would be close to meeting its requirements--at 94 percent--even if costs of its new aircraft grew in line with historical increases and if aircraft were retired after 20 years of service. Such large growth could be consistent with an increasing concern over threats to national security, which would lead to a larger share of U.S. gross national product being devoted to defense, and with a reallocation of funds within the Navy toward aircraft procurement, perhaps at the expense of ship procurement.

Indeed, since the Navy has already paid for the ships to expand its fleet to 600, it might seem plausible that the Navy could reallocate funds for shipbuilding and buy aircraft instead. A close look at when the Navy's carrier forces would retire, however, indicates that such a reallocation of funds to buy aircraft will not be likely in the foreseeable future. As shown in Table 13, eight carriers will reach retirement age in the first decade of the next century--even if they all receive service life extension programs (SLEPs), though only seven currently have SLEPs planned, and are retained until they are 45 years old. Because it takes seven or more years to build a carrier, the Navy would need to fund a new aircraft carrier roughly every 1.25 years over the next decade in order to maintain its aircraft carrier fleet into the next century. Given the priority accorded carriers by the Navy, this replacement schedule calls into question the Navy's willingness to allocate a larger share of the budget to aircraft.

Instead, might the Navy be able to temporarily reduce its operating and support (O&S) spending--largely funds for the Operation and Maintenance and Military Personnel accounts--to fund

TABLE 13. TIMING OF FUTURE BUDGETARY PRESSURES ASSOCIATED WITH REPLACEMENT OF AIRCRAFT CARRIERS

Carrier (Name/Number)	Year Commis- sioned	Extension Program (SLEP)	Likely Retirement Year <u>a/</u>	Year Carrier Authorized <u>b/</u>
Midway/41	1945	n.a.	1997 <u>c/</u>	1990 <u>d/</u>
Coral Sea/43	1947	n.a.	1992 <u>c/</u>	1983 <u>d/</u>
Forrestal/59	1955	1985	2000 <u>e/</u>	1992 <u>e/</u>
Saratoga/60	1956	1983	2001	1993
Ranger/61	1957	1993	2002	1994
Independence/62	1959	1987	2004	1996
Kitty Hawk/63	1961	1987	2006	1998
Constellation/64	1961	1991	2006	1998
Enterprise/65	1961	n.a.	2006 <u>f/</u>	1998
America/66	1965	1996	2010	2002
Kennedy/67	1968	2000	2013	2005
Nimitz/68	1975	n.a.	2020 <u>f/</u>	2012
Eisenhower/69	1977	n.a.	2022 <u>f/</u>	2014
Vinson/70	1982	n.a.	2027 <u>f/</u>	2019
Roosevelt/71	1986	n.a.	2031 <u>f/</u>	2023
Lincoln/72	1990	n.a.	2035 <u>f/</u>	2027
Washington/73	1992	n.a.	2037 <u>f/</u>	2029
74 <u>g/</u>	1997	n.a.	2042 <u>f/</u>	2034
75 <u>g/</u>	1999	n.a.	2044 <u>f/</u>	2036

SOURCE: Congressional Budget Office estimates using data from the Department of the Navy.

- a. Retirement date = commissioning date + 45 years. (The Navy typically assumes a 45-year life only if a carrier has gone through SLEP. For simplicity, CBO has assumed 45 years for all carriers.)
- b. The Navy typically assumes it needs an eight-year delay between carrier authorization and commissioning. Some long-lead funding would need to be budgeted even earlier.
- c. The Midway and the Coral Sea will be retained for longer than 30 years even though they have never gone through SLEP. The Coral Sea will be replaced by the Washington in 1992, and CVN-74 will replace the Midway in 1997.
- d. Authorization dates for CVN-74 and the Washington.
- e. CVN-75 will replace a Forrestal-class carrier. If it replaces the oldest of the class--the Forrestal--then the replacement date would be 1999 and the authorization date would be 1993.
- f. These retirement dates assume that these carriers will have 45-year lives even if no SLEP is planned.
- g. Carriers 74 and 75 have not been named.

investment programs? Some analysts have argued that the Administration did exactly that during the 1980s, when operating funding dropped from 65 percent of the Navy's budget in 1980 to 53 percent by 1985.

On the other hand, there may be pressure for increases in operating funds as well, because of the relationship of those funds to the capital value of the items being operated. The ratio of the Navy's O&S costs on an annual basis to its capital value has remained fairly constant historically, varying by three percentage points from 1975 to 1987. Moreover, the capital value of major Navy weapons will grow for a number of years as weapons being purchased with current large budgets enter the fleet. Thus, should this relationship between O&S funds and capital stock continue in the future, the service may have less flexibility to decrease operating accounts than is commonly assumed.

CONGRESSIONAL ACTION

The analysis in this chapter suggests that it is critically important that the Navy develop its two new fighter/attack aircraft at costs close to current estimates. If it does not, the Navy may have great difficulty in meeting its numerical requirements for aircraft. Unfortunately, history provides little basis for assuming that costs of the aircraft will be held as low as current service estimates suggest. What, if anything, might the Congress do?

At this stage in the development of both planes, most efforts involve complex design considerations that the Congress would have difficulty monitoring. Indeed, some Members of Congress consider it undesirable to become involved in such detail.

The Congress could, however, place a cap on the costs of the two aircraft at the levels now estimated by the Navy. Subsequent Navy estimates that violate that cap would trigger more detailed Congressional review or even impoundment of development funds. The Congress took similar action in 1985 with regard to the Air Force's Advanced Tactical Fighter, when the Senate Committee on

Appropriations recommended a cap on that plane's costs of within 20 percent of the Air Force's development estimate.

Such caps, however, are difficult to specify and certainly difficult to monitor, since the procurement cost of a program can be hard to determine before procurement has begun. And monitoring a cap on ATA costs could prove particularly difficult given its classification level.

Nevertheless, the Congress may still wish to use a cap or some other mechanism to raise the priority accorded the task of monitoring the cost of these new aircraft.



APPENDIX

PERCENTAGES OF NAVY REQUIREMENTS

MET IN THE YEAR 2015 UNDER

VARIOUS ASSUMPTIONS



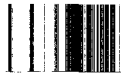


TABLE A-1. PERCENTAGES OF FIGHTER/ATTACK REQUIREMENTS MET IN THE YEAR 2015, ASSUMING 1 PERCENT ANNUAL BUDGET GROWTH

Cost Ratio of Navy ATF to F-14	Aircraft Age at Retirement	Cost Ratio of ATA to A-6		
		1.0 (Lowest Navy estimates)	1.6 (Navy estimates)	2.5 (Cost Ratio of A-6E to A-3)
1.5 <u>a/</u>	30 years	91	84	76
	25 years	79	72	64
	20 years	67	60	52
2.8 <u>b/</u>	30 years	78	73	67
	25 years	65	61	55
	20 years	53	49	44
3.6 <u>c/</u>	30 years	72	68	63
	25 years	60	56	51
	20 years	48	44	40

SOURCE: Congressional Budget Office estimates using historical data from Management Consulting and Research, Inc., *The U.S. Military Aircraft Cost Handbook* (Falls Church, Va.: MCR, March 1983), and Selected Acquisition Reports to the Congress, various years; and Department of the Navy projections of future aircraft costs.

- a. Air Force estimates of cost ratio of its Advanced Tactical Fighter to the F-15.
- b. Historical cost ratio of F/A-18 to F-4.
- c. Historical cost ratio of F-14 to F-4.

TABLE A-2. PERCENTAGES OF FIGHTER/ATTACK REQUIREMENTS MET IN THE YEAR 2015, ASSUMING 5 PERCENT ANNUAL BUDGET GROWTH

Cost Ratio of Navy ATF to F-14	Aircraft Age at Retirement	Cost Ratio of ATA to A-6		
		1.0 (Lowest Navy estimates)	1.6 (Navy estimates)	2.5 (Cost Ratio of A-6E to A-3)
1.5 <u>a/</u>	30 years	173*	158*	141*
	25 years	161*	146*	128*
	20 years	145*	131*	114*
2.8 <u>b/</u>	30 years	143*	133*	121*
	25 years	130*	120*	108*
	20 years	114*	105*	94
3.6 <u>c/</u>	30 years	130*	122*	112*
	25 years	117*	109*	99
	20 years	102*	94	85

SOURCE: Congressional Budget Office estimates using historical data from Management Consulting and Research, Inc., *The U.S. Military Aircraft Cost Handbook* (Falls Church, Va.: MCR, March 1983), and Selected Acquisition Reports to the Congress, various years; and Department of the Navy projections of future aircraft costs.

NOTE: * = meets or exceeds Navy requirements.

- a. Air Force estimates of cost ratio of its Advanced Tactical Fighter to the F-15.
- b. Historical cost ratio of the F/A-18 to the F-4.
- c. Historical cost ratio of the F-14 to the F-4.

